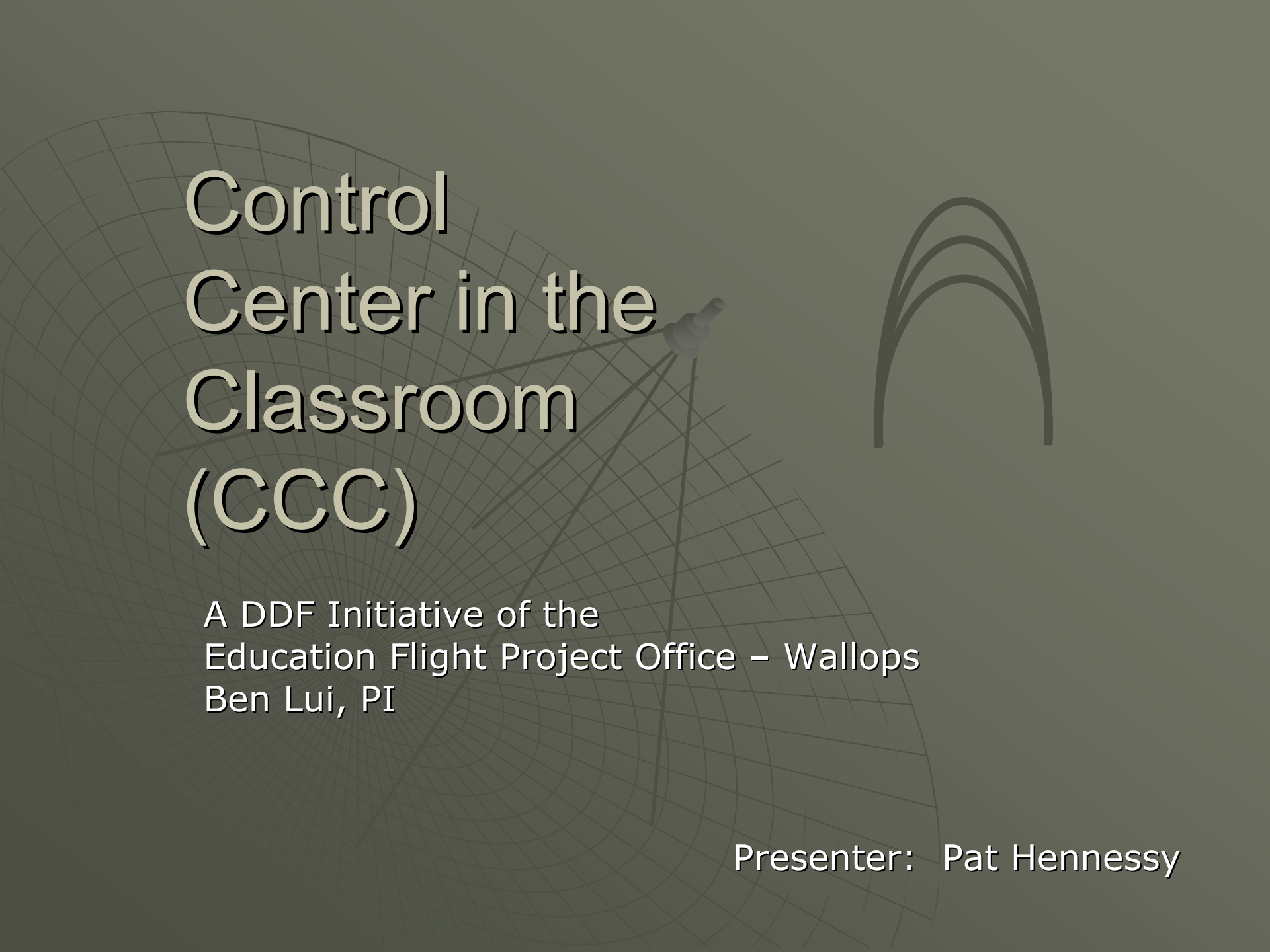


# Control Center in the Classroom (CCC)



A DDF Initiative of the  
Education Flight Project Office – Wallops  
Ben Lui, PI

Presenter: Pat Hennessy

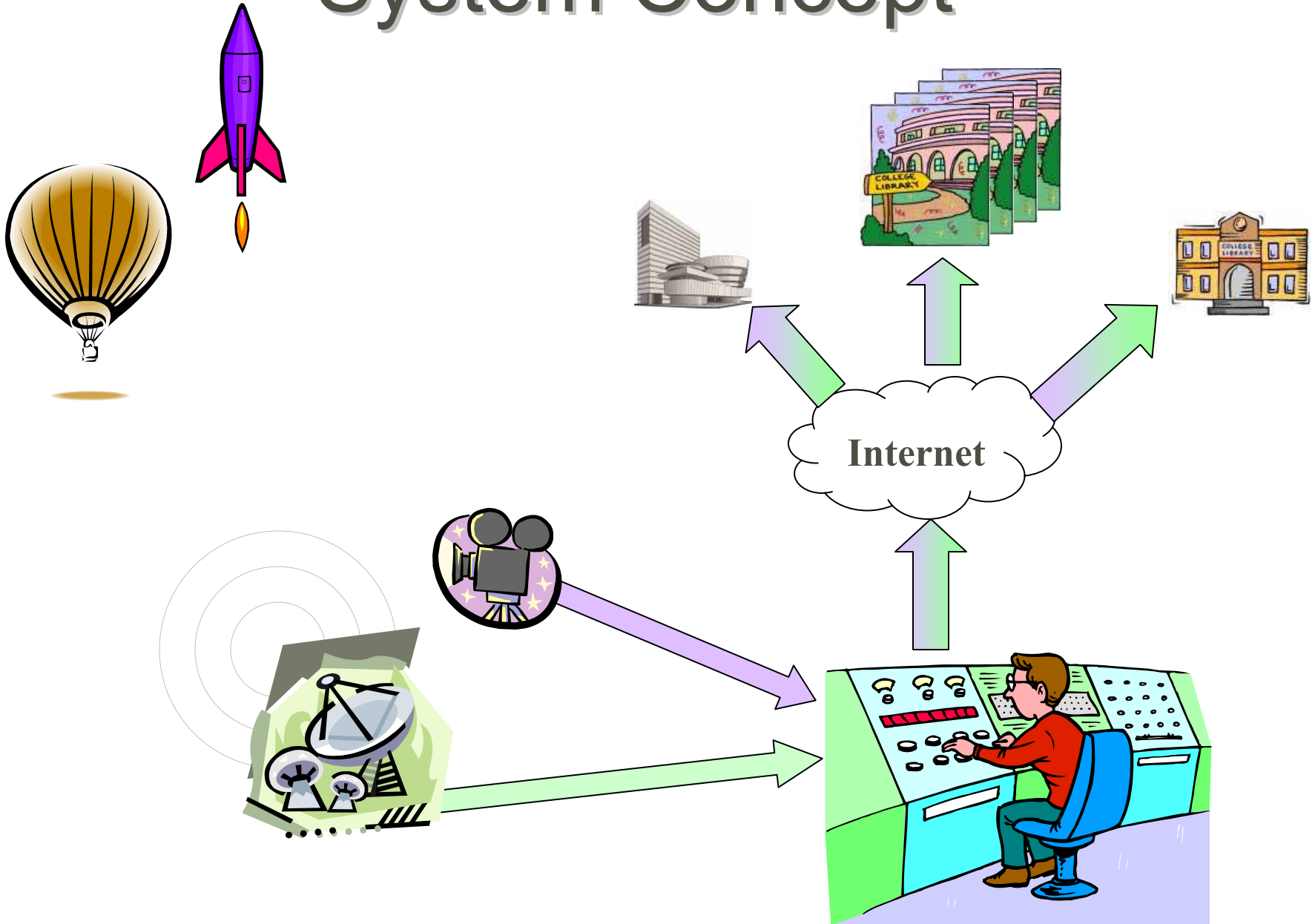
# Background

- ◆ Control Center in the Classroom is a Goddard education DDF project
- ◆ Objective: Provide an educational experience that excites and inspires students in technology and the sciences by providing opportunities for hands-on participation in real flight missions
- ◆ FY04 funding: \$35K, 1.5 FTE

# What is CCC?

- ◆ An integrated web-based system that allows
  - Students to control and monitor their flight experiments over the Internet
  - Real-time video/audio web-casting of launch and operations to the education community
- ◆ An interactive learning tool that allows
  - Students to communicate with flight ops team in real-time
  - Students to post questions (e.g., Email, IM) and get answers from NASA engineers

# System Concept



# Operations Concept

- ◆ Pre-Mission
  - Create mission specific education primers
  - Live web-cast of significant fabrication/integration activities
  - On-demand viewing of primers and pre-mission video via the web
- ◆ Mission
  - Web-cast launch events and broadcast telemetry displays in real-time
  - Allow authorized remote users to control their payloads
  - Broadcast live Q&A via the web
- ◆ Post-Mission
  - On-demand playback of mission video and telemetry
  - Provide feedback form for teacher/student comments



# Primers

- ◆ A key component in the integrated education experience
  - Tap AETD technical experts
    - ◆ Distill concepts to grade-appropriate curriculum
  - Animated and narrated
    - ◆ Professional graphics design
    - ◆ Delivery via Flash <sup>TM</sup> or similar technology

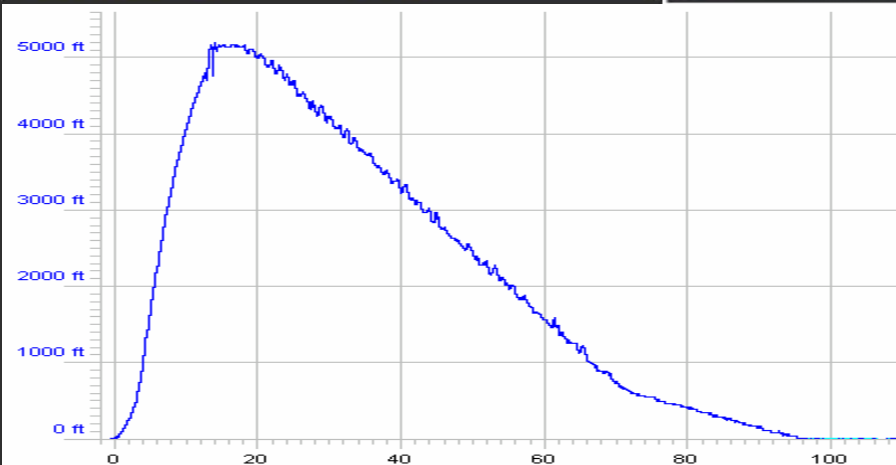
# CONTROL CENTER IN THE CLASSROOM

"A gateway to space for the next generation of explorers"

## SubSEM Flight Status

SubSem Launch Playback

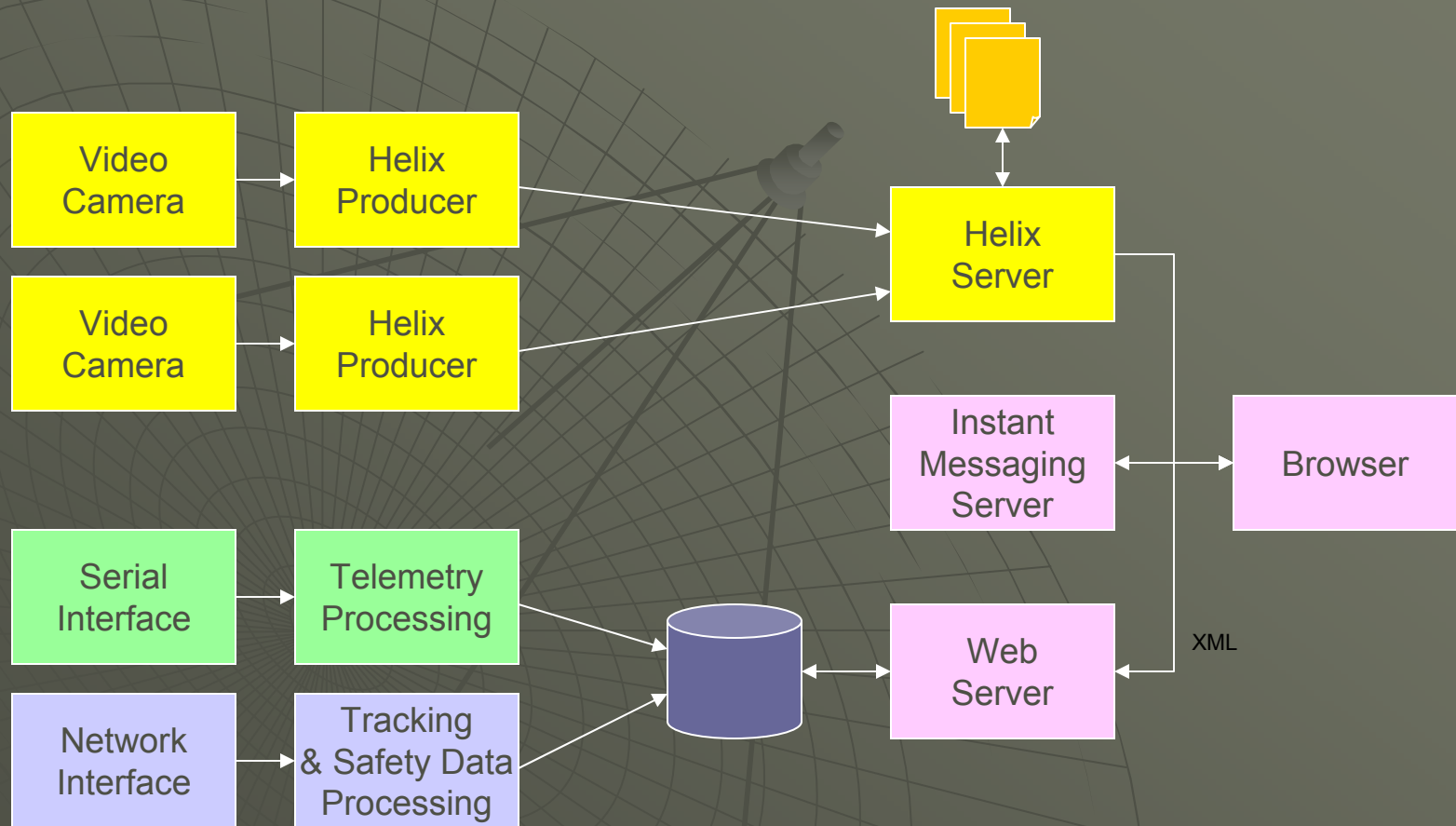
Time (GMT)	161:10:35:08.000
Mission Elapsed Time	8.0 seconds
Latitude	37.84 deg
Longitude	-75.483 deg
Altitude	7656.1 feet
Horizontal Range	379.2 feet
Velocity	249.8 feet / second
Best Radar Azimuth	141.3 deg
Best Radar Elevation	84.3 deg



Enable  
Sensor

Disable  
Sensor

# System Architecture





# Applied Technologies

- ◆ Industry-standard video web-cast technology
  - Challenge: synchronize video with telemetry
- ◆ Web based client/server approach
  - Servlets, applets, Java web-start
- ◆ Object-oriented programming languages
  - Java, Python
- ◆ XML
  - To facilitate data processing by students
- ◆ Database driven system
  - To facilitate telemetry analysis

# XML Usage

Student

CCC

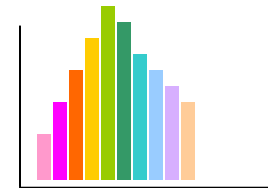
```
<?xml version="1.0" encoding="UTF-8" ?>
- <subsem>
  - <subsemarchive>
    <id>1</id>
    <datetime>161:10:35:03.031</datetime>
    <met>0.1</met>
    <alt>667.3</alt>
    <rng>7402.7</rng>
    <vel>756.3</vel>
    <az>145.2</az>
    <el>4.0</el>
    <lat>37.823</lat>
    <lng>-75.468</lng>
  </subsemarchive>
  - <subsemarchive>
    <id>2</id>
    <datetime>161:10:35:03.046</datetime>
    <met>0.2</met>
    <alt>666.9</alt>
    <rng>7402.6</rng>
    <vel>6.3</vel>
```

```
import java.awt.event.*;
import java.applet.Applet;

public class SubSemData extends Applet implements Runnable
{
    private int rate, delay;
    private boolean liveMode = true;
    private int dataFields = 9;
    private TextField tf[] = new TextField[dataFields * 2];
    final String servlet = ":8080/ccc/dxs?";
    final String login = "uid=proguser&pw=progpas&";
    final String db = "db=subsemtlm&";
    final String queryLive = "query=select%20*%20from%20sub";
    final String querySequential = "query=select%20*%20from";

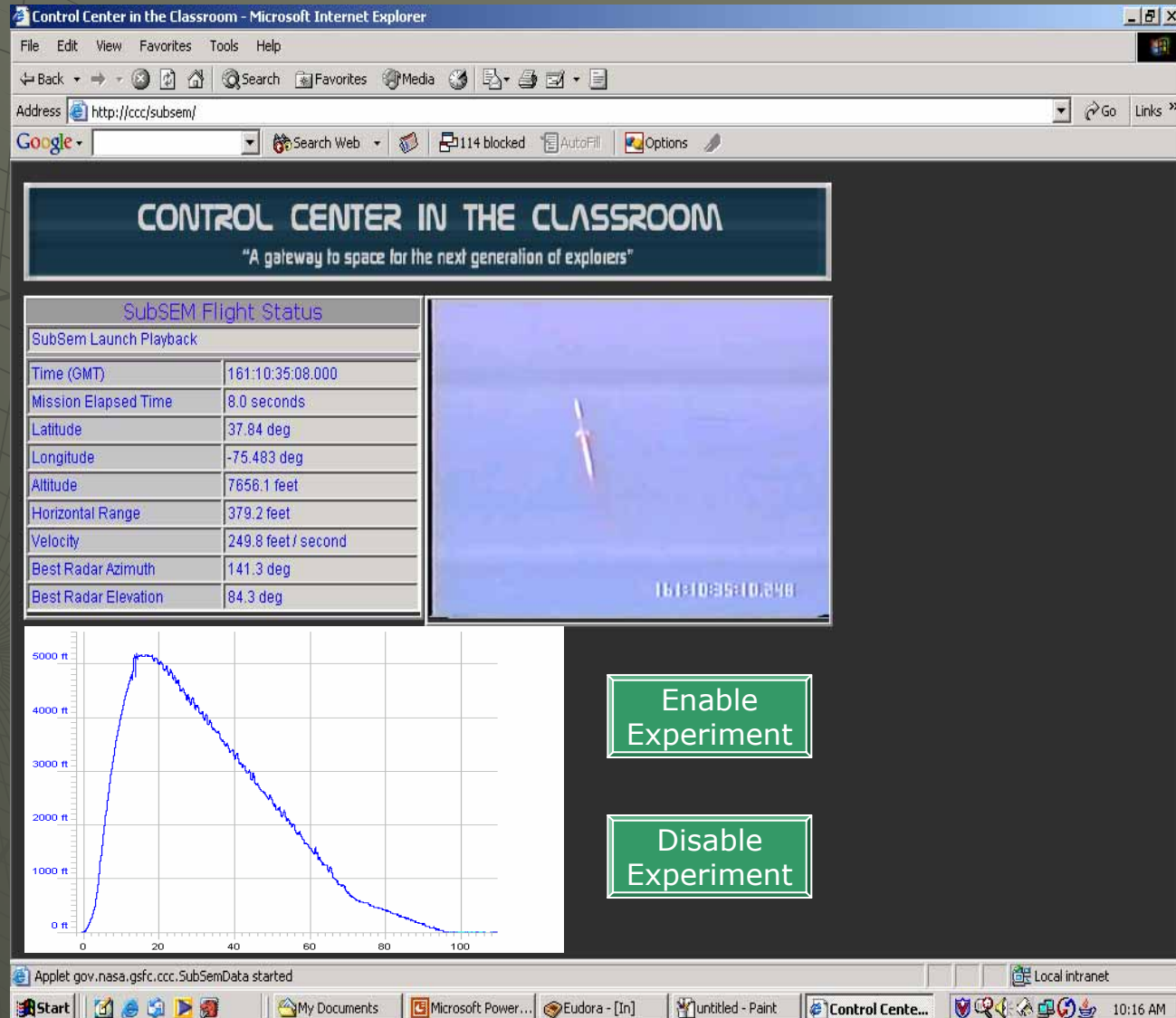
    String url;
    xmlReader xmlData;

    public void init()
    {
        // process parameters
        int color;
        String bgColor = getParameter("bgColor");
```



# Database usage

- ◆ Post-mission
- ◆ On-line TLM
- ◆ Browse-able
- ◆ Facilitates ad-hoc analysis



# Mission

## SEM-B (Student Experiment Module - Balloon)

- ◆ Supported SEM-B mission on May 3, 2004
  - Web cast live launch and on-board video
  - Real-time GPS data updates
  - Real-time altitude plot
  - Rapid turnaround (2 weeks from start to launch)
  - [www.wff.nasa.gov/semb](http://www.wff.nasa.gov/semb)



# Mission

## SUB-SEM (Sounding rocket)

- ◆ Supported SUB-SEM mission on June 9, 2004
  - Web-cast live launch video
  - Real-time broadcast of radar tracking data
    - ◆ Altitude, range, velocity
    - ◆ Az/EI
    - ◆ Lat/Long
  - [www.wff.nasa.gov/~nasaed/subsem](http://www.wff.nasa.gov/~nasaed/subsem)





# Mission

## Small-scale Educational Rocket Initiative (SERI)

- ◆ Plan to support 3 SERI launches
  - Two launches in Oct/Nov time-frame
    - ◆ Live web-cast rocket launch
    - ◆ Real-time telemetry display
  - Third launch TBD
  - [www.wff.nasa.gov/seri](http://www.wff.nasa.gov/seri)



# Upcoming missions

- ◆ Working with the Laboratory for High Energy Astrophysics (GSFC Co 660) to support an education instrument (UV camera) on the NightGlow/CosmoCam mission
- ◆ Working with Aerosonde (UAV) to support their education community
  - [www.aerosonde.com](http://www.aerosonde.com)

You know that the  
using Instrument  
Control may be  
Just be ready for  
question as to w  
not viable for thi  
application.

# FY 05 Plans

- ◆ Requesting DDF 2<sup>nd</sup> year extension
  - \$35K
  - 1.5 FTE
- ◆ Working on:
  - Video/telemetry synchronization
  - Secure commanding
  - Messaging mechanism between NASA controllers and students
  - Example primers

# Spin-off / Collaboration

- ◆ Space Operations Learning Center
  - Partnering with the Space Network Project (GSFC Code 452) to develop a “Space Operations Learning Center”.
  - ◆ Objective: create a stimulating environment for students to learn about satellite operations through 3-D graphical displays and hands-on simulation tools
  - ◆ CCC provides the infrastructure
  - ◆ Details still being worked



# Concept

- ◆ Three types of learning centers:

- Primary Learning Center
  - ◆ Proximate to a real Operations Control Center
- Remote Learning Center
  - ◆ NASA Visitor Centers, Space Museums, Science Centers across the country
- Virtual Learning Center (VLC)
  - ◆ Web-based

**Remote Learning Center**



**Primary Learning Center**



**Virtual Learning Center**

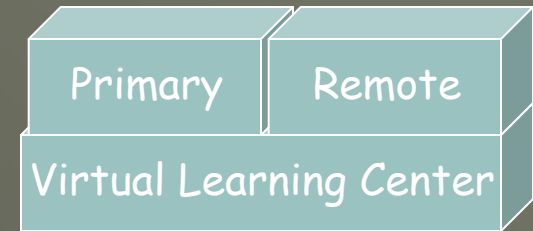


Internet



# First Steps

- ◆ Learning Centers
  - VLC is the foundation
  - Primary and Remote Learning Centers will build on VLC

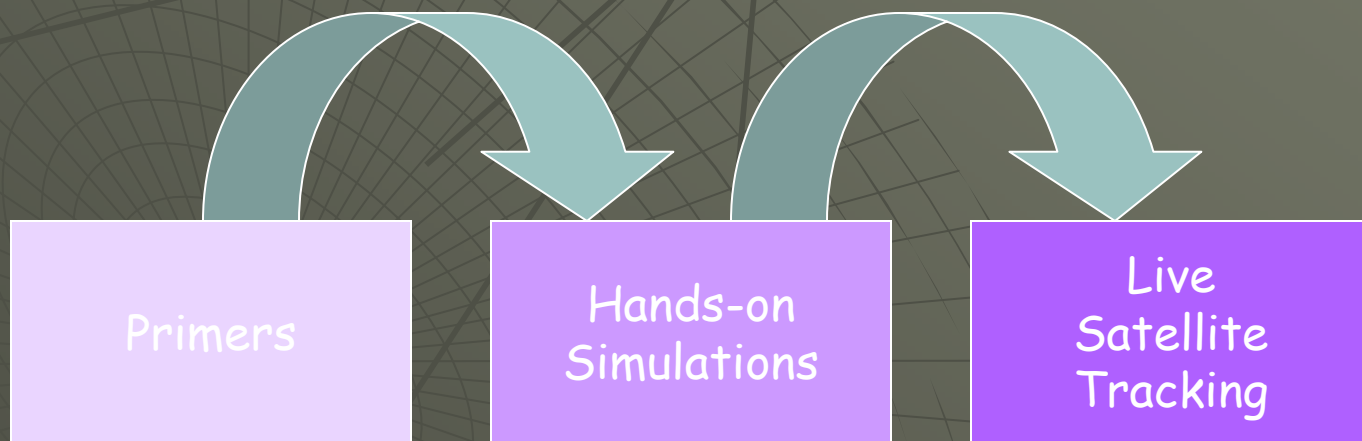


- Education Levels
  - NASA Explorer Schools (grade 4 to 9) first
  - Secondary and college level later

# Virtual Learning Center

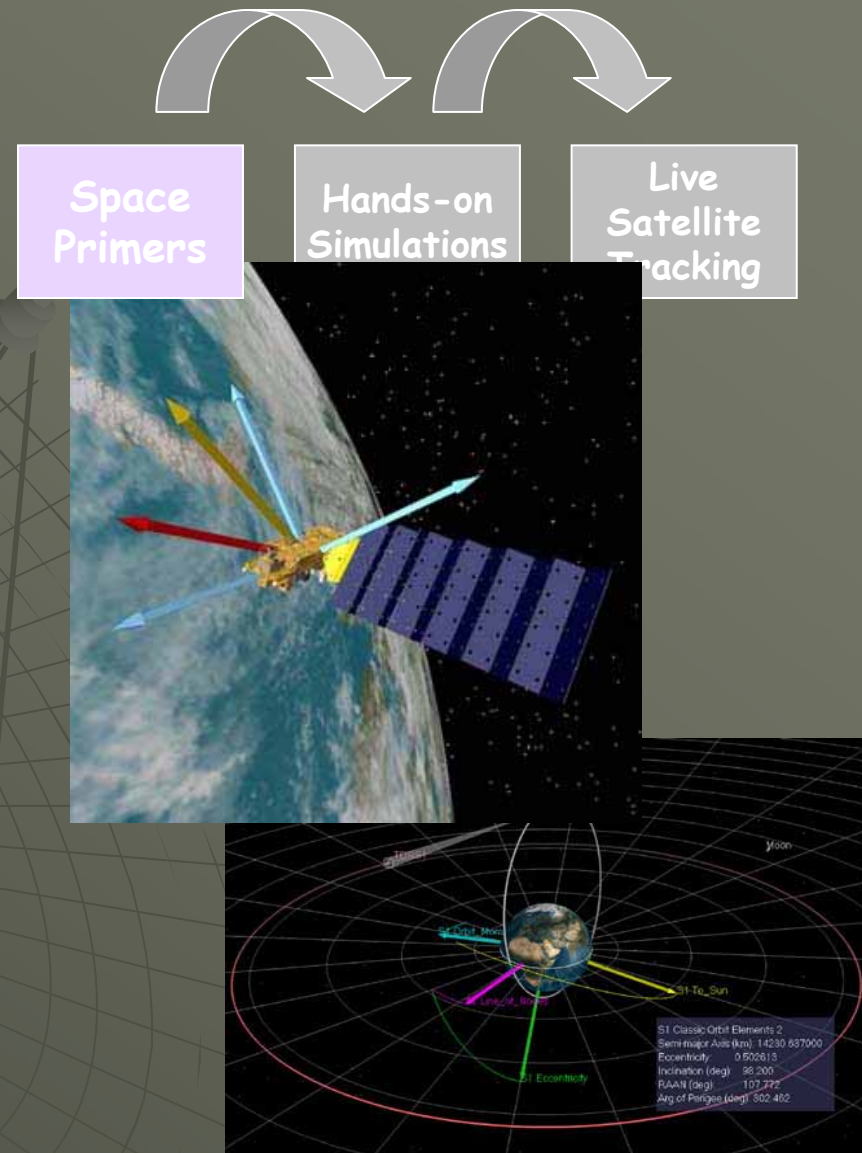
a web based learning environment

## 3-Step Learning Process



# Primers

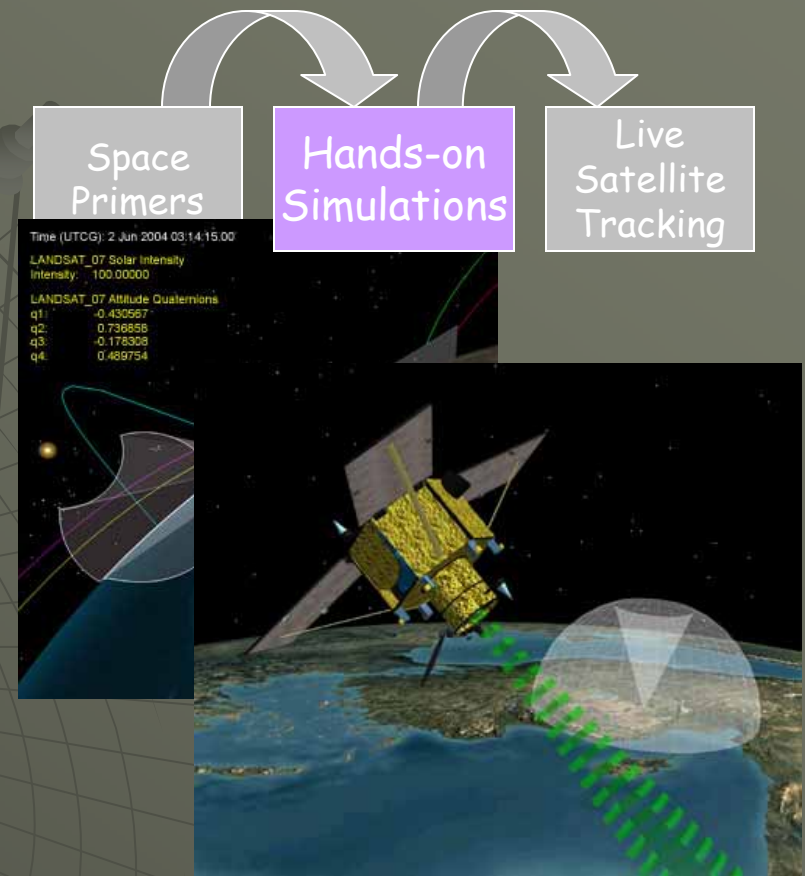
- ◆ Primers developed on the following topics
  - Satellite Operations
  - Tracking Station
  - Orbital Mechanics
- ◆ Created in 3D animation in Flash or Mpeg (web downloadable)



# Satellite Operations Simulation

## Hands-on simulation

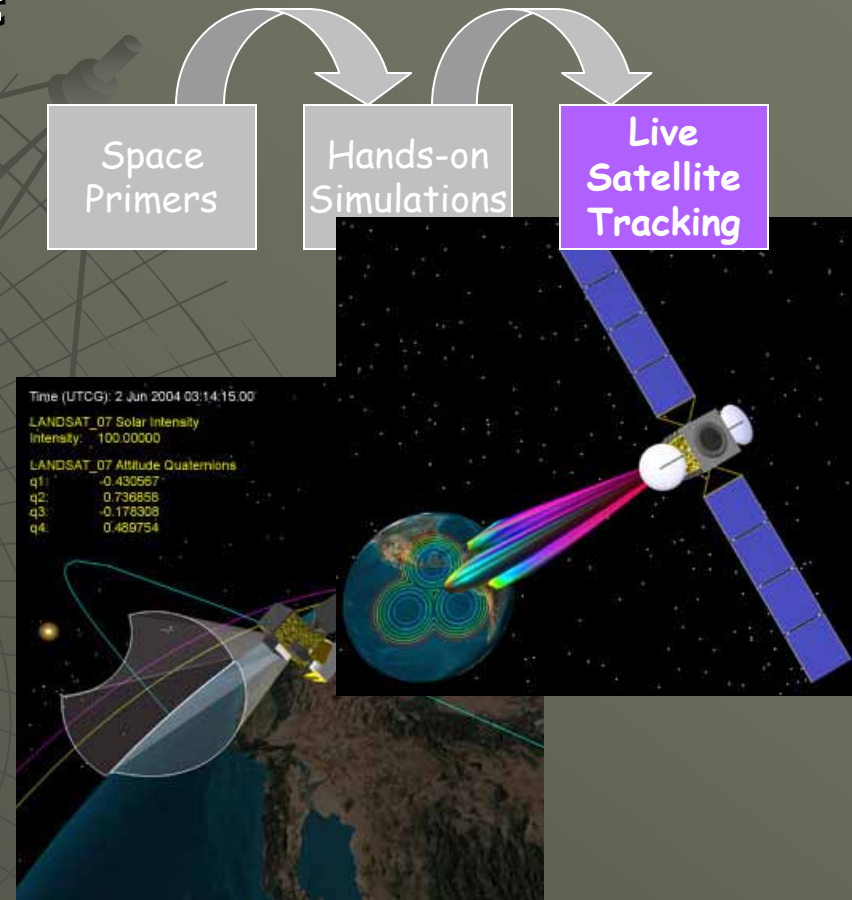
- Determine satellite orbit and attitude
- Send commands to control the satellite
- Obverse result via 3D animation and numeric displays





# Satellite Tracking

- ◆ Track live satellite via
  - Live data feed
  - Satellite Tool Kit (STK)





# Acronyms

- ◆ CCC - Control Center in the Classroom
- ◆ DDF - Director's Discretionary Fund
- ◆ GPS - Global Positioning System
- ◆ IM - Instant Messaging
- ◆ SEM - Student Experiment Module
- ◆ SERI - Small-scale Educational Rocketry Initiative
- ◆ STK - Satellite Tool Kit
- ◆ TLM - Telemetry
- ◆ UAV - Un-manned Aerial Vehicle
- ◆ VLC - Virtual Learning Center
- ◆ XML - Extensible Mark-up Language